Physical FITNESS

CAPTAIN PAUL M. VANDERBURGH

Physical fitness is an integral part of training in today's Army. We have focused a lot of attention on Army Physical Fitness Test (APFT) performance, as well as on weight control and military bearing. Although weight control and APFT performance are quite different from warfighting fitness, chances are that a soldier who performs well in both has a better chance of adapting to the physically demanding rigors of a future battlefield than a soldier who is overweight or scores poorly on the APFT, or both.

It is fairly well established that today's Army is aware of the emphasis placed on physical fitness and weight control. It may be just as important, however, to ask how much our leaders actually know about the principles of fitness and weight control? If leaders are trainers, and if physical fitness is an integral dimension of training, then leaders should be knowledgeable of the basic concepts of physical fitness.

Master fitness trainers are available to help commanders

develop physical fitness training programs, but they are not dispersed down to battalion level in every Army unit. Furthermore, commanders who rely too heavily on their master fitness trainers are not taking it upon themselves to become technically proficient in the concepts of physical training. Since commanders must administer the Army's weight control program and must decide the fate of soldiers who cannot achieve its standards or those of the APFT, such a proficiency seems imperative.

At the United States Military Academy, all cadets are now enrolled in the Master Fitness Trainer Program. When they graduate and successfully complete the program, they will have the skill identifier that certifies them accordingly. As members of each successive class join the Army's ranks, fitness training proficiency will be more apparent at the leader level. (Since the 1990 class was the first to graduate as master fitness trainers, this process will take time.) Such certification would also be beneficial as a prerequisite for commissioning from the Reserve Officer Training Corps or Officer Candidate School programs.

In a research study conducted in 1988 at the University of Georgia, we administered a 20-question test (shown in the accompanying box) to 139 lieutenants in officer basic courses and 121 captains in officer advanced courses (from the Infantry, Signal, Military Police, and Chemical Schools), to evaluate their physical fitness knowledge. The overall average was 63.9 percent, with the captains scoring slightly higher (65.7 percent) than the lieutenants. Although this difference was statistically significant, there were no statistically significant differences in scores between branches.

Whether these results are surprising, and whether they are satisfactory, is questionable. Considering the amount of instruction the average captain or lieutenant receives on physical fitness concepts in his normal military schooling, these results may even seem commendable.

BEFORE READING FURTHER, TAKE THE TEST YOURSELF. GIVE YOURSELF FIVE POINTS FOR EACH CORRECT ANSWER AND SEE IF YOU CAN BEST THE AVERAGES. ONLY THEN, AFTER YOU HAVE COMPLETED THE TEST, SHOULD YOU READ THE FOLLOWING.

Here are the answers to the test:

1.(a): Of the tests listed, the maximum bench press lift is the best index of muscular strength, because strength is defined as the maximum amount of force that can be generated in *one* repetition. In fact, tests that measure approximately five or fewer *repetition maximums* (the maximum number of repetitions that a person can perform of a particular exercise before muscle fatigue) are fairly good measures of muscular strength. The best answer, though, is a *one repetition maximum test.*

2.(d): Generally, the best exercise for improving push-up proficiency is *push-ups.* (The same is true for sit-ups, pull-ups, squats, bench presses.) This is the principle of specificity: Performance is improved the most if a person not only trains the muscle groups involved but also trains them in the same way they will be tested.

There is evidence that performing what is normally a muscular endurance exercise in a *strength* mode (such as heavy bench pressing instead of push-ups) can improve performance in the muscular endurance mode. It is quite possible, then, the most desirable push-up conditioning program is one that incorporates both APFT push-ups and "heavy" push-ups — that is, bench presses. But this has not been substantiated in any research studies that we are aware of. Other exercises can help, especially if they affect other muscles that aid in the performance of the push-ups.

3.(b): Again, as in question 2, the principle of specificity applies. Even inclined sit-ups (as in answer **a**) or weighted sit-ups (as in answer **c**) are not as effective in improving sit-up performance as sit-ups themselves. But they can improve other dimensions of the abdominal muscles that are not measured by the sit-up test, and they can break the monotony of a routine of all sit-ups.

4.(a): Muscular endurance is defined as the ability of a muscle group to sustain repeated contractions, usually 20 or more, before tiring. Obviously the sit-up test best fits this category. One might wonder why the 100-yard dash does not. The answer is that the 100-yard dash primarily measures repeated contractions of leg muscles but is not limited by muscle fatigue; in fact, muscle fatigue is usually not attained in a 100-yard dash. Even in longer runs (200 to 400 meters, for example), the limiting factors rarely include muscle fatigue. These factors are more likely maximal sustained muscular power and anaerobic/aerobic capacity. A 20-foot rope climb test, if done properly, usually requires four or five repeated contractions, so it fits more into the category of muscular strength testing.

5.(c): This is another illustration of the principle of specificity, not only in the modality (running) but in the type of running. The two-mile run is a test of aerobic power and the principal limiting factors in performance are maximal oxygen consumption and aerobic threshold.

Maximal oxygen consumption is the maximum amount (expressed as a rate) of oxygen that can be extracted from the capillaries during maximal exercise. The aerobic threshold is the exercise intensity at which lactic acid, the primary fatigue mechanism, starts to accumulate in the blood stream. Although oxygen consumption and aerobic threshold are related, one does not necessarily predict the value of the other.

Maximal oxygen consumption is improved best by high intensity runs (those that are about 45 seconds per mile slower than a runner's best two-mile run average speed per mile), which tax the body's aerobic systems. The duration of these runs is probably 15 to 25 minutes; any longer and the high intensity needed probably cannot be sustained.

The aerobic threshold is best improved by very high intensity runs of shorter duration, called intervals. Intervals, such as repeats of one-fourth or one-half mile, done once or twice a week, will raise the lactic acid threshold. The

TEST YOUR KNOWLEDGE

1. Of the following, the one that best measures muscular *strength* is:
   a. Maximum bench press lift.
   b. Two-minute push-up test.
   c. Pull-up test.
   d. 100-yard dash.

2. Of the following, the best routine for increasing APFT push-up performance is:
   a. A routine of pull-ups, dips, and arm curls, 3 days a week, 20 minutes a day.
   b. Heavy weight training (6-10 repetitions before muscle fatigue) for all major upper body muscle groups, 3 days a week, 20 minutes a day.
   c. Light weight training (25 or more repetitions before muscle fatigue) for all major muscle groups, 3 days a week, 20 minutes a day.
   d. Performing push-ups until exhaustion twice a day.

3. Of the following, the best routine for improving APFT sit-up *performance* is:
   a. 15 repetitions of steep (30 degrees) inclined sit-ups, once a day.
   b. 100 APFT-standard sit-ups once a day.
   c. 15 sit-ups with heavy barbell weights held to the chest, 3 sets a day, 4 days a week.
   d. Nautilus (or other name brand) abdominal machine, 10 repetitions per set, 3 sets a day, 4 days a week.

4. Of the following, the one that best measures muscular *endurance* is:
   a. APFT sit-up test.
   b. Maximum bench press lift.
   c. 100-yard dash.
   d. 20-foot rope climb test.

5. Of the following, the best routine for improving two-mile run time on the APFT is:
   a. Run 4-6 miles, 6 times a week, at a slow pace.
   b. Run 7-8 miles, 3 times a week, at a slow pace, and run 3 miles 3 times a week at a medium pace.
   c. Run 2-3 miles, 3 times a week, at a fast pace, and run 1/2 mile 5 times (2 minutes rest between runs), 2 days a week, at a very fast pace.
   d. Run 3 miles, bicycle 10 miles, and swim 1 mile — each 2 days a week at a fast pace.

6. PVT Tentpeg is a reasonably fit individual who can do 50 push-ups on the APFT. He starts a program of 100 push-ups a day, 2 sets of 50 (at APFT speed), every day for 6 months. At the end of 6 months, the most likely changes that will have occurred in his body and level of conditioning are:
   a. The muscles of his chest and arms will have significantly increased in size, and he will be able to lift twice as much weight with his arms and chest as he could before.
   b. He will have lost a considerable amount of excess fat around his arms, chest, and shoulders, and will have significantly improved his 2-mile run time.
   c. Not much will have changed in his physique or conditioning level, as he can already do 50 push-ups.
   d. He will not have altered his physique much in terms of muscle size, but will be able to perform considerably more APFT-standard push-ups.

7. SGT Gronk is overweight but still scores rather high on the APFT in all events. Select from the following the best program to reduce his weight, both in the short term and in the long term:
   a. A moderate diet and slow to moderate 5-mile runs, 5 days a week.
   b. A moderate diet and fast-paced 2-mile runs, 5 days a week.
   c. A highly restrictive diet with significant cuts in his daily food intake but no physical conditioning as he is already in good APFT-standard condition.
   d. A moderate diet and heavy weight training for all major muscle groups of the body, 3 or 4 days a week.

TRUE OR FALSE

8. _____The best way to remove excess fat from around the waist is to perform many abdominal exercises on a regular basis.

9. _____Regular weight training is more effective in reducing excess body fat than regularly done exercises like running, swimming, and bicycling.

10. _____The reduction in body weight in the early stages of a diet-only routine (without exercise) will be due mostly to lost body fat.

11. _____One will burn roughly the same number of calories running 5 miles in 30 minutes as running the same distance in 45 minutes.

12. _____The APFT two-mile test primarily measures the heart, lung, and leg capacity for endurance at a high intensity.

13. _____For people who do not like running, weight training done regularly with very little rest between exercises (so that the heart rate stays elevated) is just as effective in improving two-mile run time on the APFT as running regularly.

14. _____If one expends more energy (in calories) than one consumes in food (calories), he will lose weight.

15. _____The push-up is *primarily* an arm and chest exercise.

16. _____The sit-up will condition (or tone) the muscles of the lower back just as much as the muscles of the abdomen (in the stomach area).

17. _____The best way to increase muscle strength and size is with regular, heavy weight training (6-10 repetitions before muscle fatigue).

18. _____The primary causes of obesity are inactivity and overeating.

19. _____Body fat accumulation is much more substantial in inactive areas of the body.

20. _____In trying to improve performance on the APFT two-mile event, longer distance, slower pace training is preferable to shorter distance, faster pace training.

combination of these two techniques will be most beneficial in improving two-mile run times. We would not recommend that such a program be done throughout the year, but two months before an APFT would be ideal.

Based on all of this, formation runs at a shuffle pace are not appropriate (although they are better than nothing) for units that are specifically trying to improve their times on two-mile runs. A person must run at high intensity to get the best two-mile run performance.

6.(d): Push-ups are a muscular *endurance* exercise; one can usually perform many more than 20 repetitions before muscle fatigue sets in. The changes or adaptations that result from such a push-up exercise program can be grouped basically into one major change: an increased oxidative capability of that muscle group *without* a change in muscle size or loss of local body fat. This translates into that muscle group's increased ability to do many repetitions of a particular exercise. A muscular *strength* training regimen such as heavy weight training, in which few repetitions are done (6 to 10) before the onset of muscle fatigue, results in hypertrophy, or larger muscle fibers and greater strength. This does not necessarily mean more *endurance.*

It follows, then, that a heavy weight training program will not lead to the same improvement in push-up performance as push-ups themselves. A person who bench presses (high weight, low repetition) regularly, however, will probably still perform reasonably well on the push-up test, but primarily because of his increased *strength.* With training, each push-up repetition becomes a smaller percentage of maximum strength, so the point of muscle fatigue is delayed.

There is a possibility that a combination of push-ups and heavy weight training (particularly the bench press) may prove to be the best regimen to use in preparing for the push-up portion of the APFT, but there are no studies to substantiate this. The best fitness program, nonetheless, is one that develops not only muscular endurance but strength as well.

Body fat is lost primarily through aerobic exercise (not through muscular strength or endurance regimens) but in relatively equal amounts throughout the body. The exact pattern of fat loss is determined genetically and physiologically; this explains why different people store and lose fat in different regions of the body.

7.(a): Again, aerobic training is the best exercise for reducing body fat. (Loss of a certain amount of body fat is the primary objective of any weight loss program.) Weight training increases lean mass (muscle) but has not been clearly shown to be effective in reducing fat mass. A sound dietary approach should be coupled with a good aerobic exercise program.

Only moderate changes in one's eating habits hold any promise of working over a long term. Severe caloric restriction can be maintained only for a short period, is extremely unhealthy, lowers resting metabolic rate, and is therefore rarely ever successful in keeping off lost weight. Exercise programs designed to promote weight loss can be quite different from those that promote improved times on the two-mile run. The latter requires high intensity; the former does not.

Weight loss is a matter of energy balance; if a person expends more energy than he consumes, under normal circumstances, he will lose weight. It does not matter whether this energy expenditure comes from high or low intensity exercise. If the total work done is the same, then intensity becomes irrelevant.

Consider this: A man expends about the same number of calories running five miles, whether he runs it in 30 minutes or 50 minutes! This is a key point for commanders to impress upon their overweight soldiers. A good run distance for a weight loss program is five miles, at any speed.

8.(False): This is a big misconception. Many still think that "spot reducing" is a good technique for fat loss. It simply does not work. When a body needs fat for fuel, it mobilizes that fat in a fairly uniform manner, not on the basis of the muscle groups used. Some fat stores are more easily reduced than others, but this is determined genetically and hormonally. As stated before, aerobic exercise is the best for reducing body fat.

9.(False): Weight training, especially heavy weight training, can increase muscle mass but has not been shown to reduce fat mass nearly as effectively as aerobic training. Furthermore, the total work done in a 45-minute weight training session is much less than that done in 45 minutes of reasonably intense aerobic activity. Since energy balance is a key factor in weight loss, the advantage lies in aerobic training.

10.(False): In the early stages of a diet-only program, most of the weight loss is water. When the body is deprived of food, it consumes — among other stored fuel sources — its own stored carbohydrates. In this process, with each carbohydrate molecule consumed, several water molecules are lost. This is why weight loss, early in a diet, seems quick and easy, but these effects are short-lived.

11.(True): Again, if total work is the same (which it is in a set-distance run) then calorie expenditure is also roughly the same. (See question 7, above.)

12.(True): This, in a nutshell, is what the APFT two-mile run is all about.

13.(False): Here is another common misconception. Circuit weight training, according to the latest studies, does *not* benefit the cardiovascular system in such a way as to improve aerobic capacity. Although heart rate may be within the "training zone," there is no corresponding increase in oxygen consumption during such exercises. Only a sustained and elevated rate of oxygen consumption such as that found in aerobic exercise can bring about improvements in aerobic capacity.

14.(True): Again, this is the energy balance equation theory, which for healthy people, works fairly well.

15.(True): In analyzing body movement and muscle action, one can think of the human body as a system of levers (bones) moved by attached rubber bands (muscles). Muscles can only pull; they can never push. Therefore, the only muscle groups that are *primarily* involved in the push-up are those involved with arm extension (triceps) and shoulder flexion (pectorals).

16.(False): Again, muscles can only pull, and the primary ones that pull in the sit-up exercise are the abdominals and hip flexors. The back muscles are hardly taxed in the sit-up.

17.(True): As in answer 6, muscular strength is best improved by heavy weight training in which six to ten repetition maximums are performed for each muscle group. It may be important to point out that six to 10 repetitions are preferred over a one-repetition maximum lift. This is because the total amount of work done in the former, while still in the *muscular strength* window (less than 12 repetitions before muscle fatigue), is far greater than that done in the latter. Hence, overload on the muscle is at its highest.

18.(True): No rocket science here. The combination of the two almost always indicates an onset of obesity. We at West Point believe, however, that if the exercise program is regular enough and intense enough, a person can eat just about as much as he wants (of good foods) and still maintain a desirable body weight and composition.

19.(False): This is the reverse of the spot-reducing idea, and it is equally unfounded. Fat deposit is genetically determined and controlled by hormones in the blood, based on the energy demands of the body. Men typically store excess fat in the abdominal region, and women typically in the hip region. This has nothing to do with inactive stomachs or hips!

20.(False): See answer 5 above.

Try this test on the leaders in your unit. Use the discussion section as a guide to bring home some of the important teaching points. Solicit the help of a master fitness trainer in setting up a professional development session so that the members of your unit can begin to understand what is behind a unit physical fitness program. (Consult Army Regulation 21-20 for exercise program guidelines.)

We recommend that the ideal fitness program be one that ensures not only success on the APFT but also success in performing the unit's mission and in improving its members' quality of life. If your unit is expected to roadmarch, then make roadmarching a regular part of your program. If your soldiers are expected to lift heavy materiel (tank or artillery rounds) or perform heavy equipment maintenance and the like, be imaginative in devising a fitness program that will develop these specific proficiencies. If your unit does nothing physically demanding on the battlefield, make sure your fitness program develops at least aerobic capacity and muscular strength and endurance.

Remember that your unit fitness program is not just what your soldiers do together; it also includes individual effort and time on the part of each soldier in making sure he eats healthy foods and works out regularly and completely.

Captain Paul M. Vanderburgh is deputy director of the Sports Medicine Branch and a physical education instructor at the United States Military Academy. He previously served in the 2d Infantry Division in Korea. He is a 1982 graduate of the Academy and is now pursuing a doctorate in exercise physiology at Columbia University.